Table 3. Kelp bass summary table.
Italics indicate estimated values. Biomass density values for segments 8 and 9 estimated from average of segments 4, 5, 6 and 7. Biomass density values for 1981-91 for segments 4.5-7 estimated from 1992-96 values.

	Segment Number									
	3	4	4.5	5	6	7	8	9		
Prop. of fish exceeding threshholds										
1981-1986										
5 ppm	**0.00**	**0.05**	**0.15**	*0.15*	*0.15*	*0.15*	**0.29**	**0.00**		
1987-1991										
5 ppm	**0.00**	**0.00**	**0.02**	*0.00*	**0.00**	**0.00**	*0.00*	**0.00**		
1992-1996										
0.1 ppm	**0.60**	*0.60*	**0.70**	*0.70*	*0.70*	**0.87**	no data	no data		
biomass/segment (kg)										
biomass density (kg/ha)										
1981-1986	107.61	107.61	*39.03*	*39.03*	*33.67*	*114.80*	*73.78*	*73.78*		
1987-1991	61.96	61.96	*39.03*	*39.03*	*33.67*	*114.80*	*62.37*	*62.37*		
	69.08	69.08	39.03	39.03	33.67	114.80	*64.15*	*64.15*		
area/segment (ha)										
based on 1989 photos	144	95	40	17	20	68	41	33		
Biomass/segment (kg)										
1981-1986	15,496	10,223	1,561	664	673	7,806	3,025	2,435		
1987-1991	8,922	5,886	1,561	664	673	7,806	2,557	2,058		
	9,948	6,563	1,561	664	673	7,806	2,630	2,117		
TOTAL YEARLY BIOMASS EXCEEDING THRESHOLD (kg)										TOTAL
1981-1986	0	511	234	100	101	1,171	864	0		2,981
1987-1991	0	0	31	0	0	0	0	0		31
1992-1996	5,969	3,938	1,093	464	471	6,766				18,700

Table 4. Black surfperch summary table.
Italics indicate estimated values. Biomass density values for segments 8 and 9 estimated from average of segments 4, 5, 6 and 7. Biomass density values for 1981-91 for segments 4.5-7 estimated from 1992-96 values.

	Segment Number									
	3	4	4.5	5	6	7	8	9		
Prop. of fish exceeding threshholds										
1981-1986										
	0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	0.0		
	0.0	**0.0**	**0.0**	**0.0**	*0.0*	**0.0**	**0.0**	no data		
0.1 ppm	**0.65**	*0.65*	**1.00**	*0.95*	*0.95*	**0.95**	no data	no data		
biomass/segment (kg)										
biomass density (kg/ha)										
1981-1986	35.49	35.49	*16.18*	*16.18*	*11.68*	*11.23*	*18.65*	*18.65*		
1987-1991	39.30	39.30	*16.18*	*16.18*	*11.68*	*11.23*	*19.60*	*19.60*		
1992-1996	23.43	23.43	16.18	16.18	11.68	11.23	*15.63*	*15.63*		
area/segment (ha)										
based on 1989 photos	144	95	40	17	20	68	41	33		
Biomass/segment (kg)										
1981-1986	5,111	3,372	647	275	234	764	764	615		
1987-1991	5,659	3,734	647	275	234	764	803	647		
	3,374	2,226	647	275	234	764	641	516		
TOTAL YEARLY BIOMASS EXCEEDING THRESHOLD (kg)										TOTAL
1981-1986	0	0	0	0	0	0	0			0
1987-1991	0	0	0	0	0	0	0			0
1992-1996	2,193	1,447	647	261	222	725				5,496

In addition to the underestimate due to the lack of exceedance estimates for some segments and time periods, injuries may have been underestimated for segments for which exceedances had to be estimated from data in other segments or time periods. The rules adopted for estimating exceedances (see Appendix 2) were developed to ensure that exceedances were not overestimated, and consequently some estimated values may be low. Other examples where the exceedance values are likely to provide a lower bound estimate of true values are given in Appendix 2.

3.2. Standing stocks

Standing stock estimates for the two target species occurring in soft-bottom habitats were estimated from trawl data. Standing stock estimates for the two species occurring on rocky reefs were estimated from diver surveys. In all cases, all sizes of fish collected in the sample (trawl or diver survey) were used to calculate standing stock.

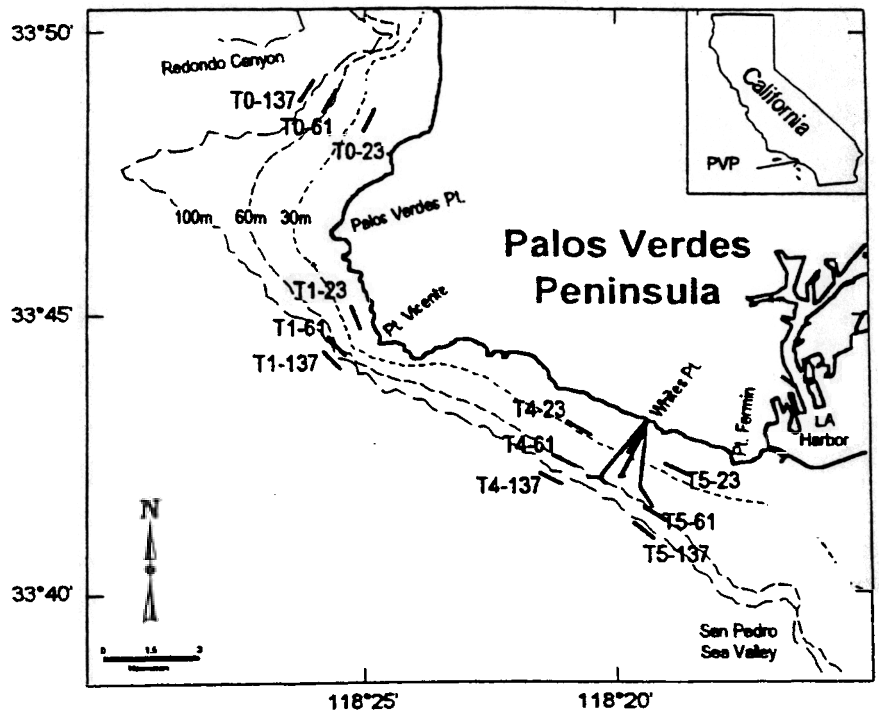
3.2.1. Soft-bottom fish on the Palos Verdes Peninsula

The abundance and biomass of fishes living on soft bottoms has been assessed using trawls. Trawls by the Los Angeles County Sanitation District (LACSD) have been conducted regularly since 1973 at twelve stations (Stull and Tang 1996). The stations are arranged into four transects (T0, T1, T4 and T5) separated by 5-8 km along the Peninsula. At each transect location, trawls were taken at three different depths, 23m, 60m, and 137m (Figure 2). The long time series and good spatial distribution of these stations make the LACSD data a good basis for estimates of soft-bottom fish biomass densities.

The trawl methods, summarized in Stull and Tang (1996), follow the standard methods for Southern California soft-bottom monitoring. An otter trawl with a 7.6 m headrope, 3.8 cm (stretch) body mesh and 1.3 cm (stretch) cod-end mesh was used. The trawl was towed on the bottom along the isobath of each station for 10 minutes at approximately 1 m/sec. The area of the trawl was calculated as time x speed x width = (10 min x 60 s/min) x 1 m/s x (16 ft/3.281 ft/m) = 600 s x 1 m/s x 4.87 m = 2922 m^2. Captured fish were identified, counted, measured and examined, and a composite of all individuals of a species weighed to the nearest 0.1 kg. Methodological issues are discussed in more detail in Southern California Bight Pilot Project Field Coordination Team (1995).

Although trawl data provide the best indicator of soft-bottom fish biomass density, the estimates presented here undoubtedly underestimate the actual biomass density. Many individuals can escape capture by a trawl, and the escapement rates vary by species, size, trawl characteristics and physical conditions. Larger fish, especially, may be able to avoid trawl nets or swim out of them, and these larger fish would add substantially to biomass estimates. No corrections were made for gear efficiencies in this report, although it is recognized that the resulting biomass density estimates are likely to substantially underestimate true biomass density (L. Allen, personal communication). J. Stephens (personal communication) considers that trawl data may capture less than half of the fish occupying the path of the trawl.

Figure 2. Stations sample by trawl during LACSD Palos Verdes monitoring.
(From LACSD 1998)



Another common problem with trawl data is the variability of trawl coverage and the difficulty of estimating the area of bottom sampled. LACSD attempts to minimize the variability of trawl coverage by using a standardized trawl duration and boat speed, but currents and small differences in boat speed will still lead to variation in bottom area covered. In addition, there may be systematic differences in area covered at different depths (J. Stephens, personal communication). However, these differences will be small compared to the underestimate due to sampling by trawl. Thus, the estimate of biomass injury is conservative.

3.2.1.1. Methods for calculation of biomass densities

Biomass densities were calculated from LACSD data provided by Dr. Jim Allen of the Southern California Coastal Water Research Project (SCCWRP). The dataset consisted of trawl data collected four times per year from 1980 (beginning 3/10/80) to 1999, plus one trawl in 2000 (2/3/2000). Most of the data were for the four main transects (T0, T1, T4 and T5). The dataset also contained data from some trawls at other transects, but these were not used because there were few trawls taken at any transect (less than 15 trawls total). I also did not use the data for 1980 because the period of interest begins in 1981, nor the data for 2000 because it consisted of only one trawl.

Biomass data were provided as composite weights of all individuals of a species caught in a single trawl, given to the nearest 0.1 kg. If the composite weight was less than 0.1 kg, a qualifier ("<") noted this in the database. In my calculations of biomass density, these weights were included as 0 kg. This provides a lower bound estimate of the true biomass, but the effect on estimates of biomass density is small.

Before actually calculating the biomass densities to be used for standing stock estimates, decisions must be made about spatial and temporal partitioning of the data. These issues are discussed in the next two sections.

3.2.1.2. Spatial variation

Because biomass density of a species may vary in space, a decision must be made regarding the treatment of data from different locations. The simplest assumption is that biomass density is distributed evenly throughout the shelf. This assumption is not supported by the data, however. The average biomass densities for white croaker and Dover sole varied by transect location and depth between 1980 and 2000 (Table 5). White croaker biomass density was generally higher at transects T4 and T5, near White's Point, and in mid- to shallow shelf depths. Dover sole biomass density was more evenly distributed among the different transects, but was very low at shallow depths.

Table 5. Average biomass densities for white croaker and Dover sole, 1980-2000. Each mean is based on 81 trawls taken from 1980 to 2000.

	White croaker				Dover sole			
	T0	T1	T4	T5	T0	T1	T4	T5
20m	0.039	0.047	1.111	9.980	0.000	0.000	0.287	0.000
60m	0.101	0.592	12.679	1.164	2.153	2.214	2.231	2.658
137m	0.308	2.746	0.101	1.739	11.957	10.233	13.043	15.202

White croakers are schooling fish that are very patchily distributed on the Palos Verdes shelf, meaning that many trawls capture few white croakers but a few trawls catch many. The location of high catches of white croaker also varied along the shelf. Hauls with >10kg of white croaker were most frequent along transects T4 and T5 and infrequent along transect T0 (Table 6).

Table 6. Distribution of trawls with high catches of white croaker among different transects (1980-2000).

	Hauls >10 kg	
Transect	Number	Proportion of Total Trawls
T0	1	0.004
T1	4	0.016
T4	15	0.062
T5	10	0.041

Because fish abundances clearly varied over the Palos Verdes Shelf, I broke the shelf into different coastal segments and calculated biomass density for each segment separately. As noted in Section 3.1, I used the segments identified by QEA.